FOOD DESERTS AND EATING HABITS OF CHILDREN PARTICIPATING IN THE WIC PROGRAM

A Thesis

by

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ABSTRACT

The USDA's "My Plate" recommends that preschool-aged children consume specific amounts of fruits, vegetables, and whole grains. These foods contain essential nutrients that children and adults alike require to maintain good health. Researchers have shown, however, that a significant number of children do not consume the recommended amounts of these foods, specifically vegetables and whole grains. Investigators have become increasingly interested in food deserts and whether living in these areas results in lower consumption of healthy foods. Food deserts by definition are areas where inhabitants have limited access to nutritious food. This study investigated the fruit, vegetable and whole grain consumption levels for preschool age children living in food desert or non-food desert areas. The NATFAN (National Food and Nutrition Questionnaire) survey of WIC participants was compared to the USDA's food desert location data in order to learn the impact of living in a food desert. Using IBM SPSS to test the hypothesis, separate two-sample t-tests were conducted to determine if the mean difference between frequencies of fruit, vegetable, and whole grain consumption equaled zero. The data showed no difference in consumption of fruits and vegetables between food desert residing children and their non-food desert counterparts. There was, however, a difference in means for the consumption of whole grains. Specifically, food desert residing participants were consuming less brown rice. Using consumption amounts estimated from frequency data, it was discovered that, overall, WIC participants were under consuming fruits, vegetables, and whole grains.

DEDICATION

To my family and my fiancé for all of their love and patience. Thank you for always encouraging and supporting me in my endeavors.

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NOMENCLATURE

FDR	Food Desert Residing
NATFAN	National Food and Nutrition Questionnaire
NFDR	Non-food Desert Residing
NHANES	National Health and Nutrition Examination Survey
USDA	United States Department of Agriculture
WIC	Women, Infants and Children

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1. INTRODUCTION

Food availability is a central factor in diet quality. The term 'food desert' has been introduced recently to describe areas with limited access to affordable and nutritious food [(1)]. The existence of food deserts is a controversial subject and the extent to which they exist is debated [(2)]. Food deserts have been most commonly defined as areas where access to healthy food is limited [(3)]. More specifically, food deserts are areas in which all residents must drive more than 10 miles to the nearest supermarket chain or supercenter [(4)]. In addition, food deserts are an area where cheap and varied food is accessible only to those who have private transport or who are able to pay the cost of public transport, if it is available [(5)].

According to the Economic Research Service's 2012 Report on food access, 8,894 people lived in food desert areas in 2010, up from 7,764 in 2006 [(6)].

It is recommended by the United States Department of Agriculture (USDA) that preschool aged children, ages 2-5 years old, consume specific amounts from each food group per day, of which are listed in Table 1 [(7)]:

Table 1: USDA Recommendations for Children

Food Group	Fruit	Vegetables	Whole Grain
Amount	2 cups	2.5 cups	>3 ounces

Research has shown, however, that most children are not meeting these requirements for both vegetables and whole grains. According to data obtained from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) and shown in Table 2, 100% of children (2-5 years old) are meeting the requirements for fruit intake, while 44% are meeting the required vegetable intake, and only 17% meet the recommended whole grain intake [8].

Table 2: NHANES Data

Average diet scores for children ages 2–17 as a percentage of Federal diet quality standards by age and dietary component, 2007–2008

Dietary component	Ages 2–17	Ages 2–5	Ages 6–11	Ages 12–17
Total Healthy Eating Index-2005 score	59	63	57	57
Dietary adequacy components[a]				
Total fruit	78	**100**	74	59
Whole fruit	92	**100**	88	71
Total vegetables	48	**44**	44	52
Dark green and orange vegetables and legumes	16	19	12	19
Total grains	100	100	100	100
Whole grains	18	**20**	18	17
Milk	84	100	79	76
Meat and beans	85	75	83	92

childstats.gov

Data analysis of the 1999-2002 NHANES estimated that as little as 50% and 22% of children aged 2-5 years old were meeting the recommendations for fruit and vegetable intake, respectively [9].

Lower income populations consume fruits and vegetables less often than higher income populations, but there is not sufficient evidence to show that they consume fewer whole grains as well [10,11,12]. To determine if food deserts have an impact on consumption of these foods, we utilized a survey performed using participants from the governmental program Women, Infants and Children (WIC).

WIC Program

The WIC program is a special supplemental nutrition program for women, infants, and children [13]. The program began in 1972 to improve the nutritional status and health outcomes of vulnerable populations [13]. WIC now provides supplemental food, nutrition counseling, and health service referrals for low-income pregnant women, breastfeeding mothers, non-breastfeeding postpartum mothers, and infants and children who are found to be at nutritional risk [13]. Nationally, more than 8.7 million women and children participated in WIC in 2008 [13]. To be eligible on the basis of income, applicants' income must fall at or below 185 percent of the U.S. Poverty Income Guidelines [13].

WIC participants are by nature a low-income population, therefore, this study compares low income food desert residing participants to low income participants who do not live in food deserts. This will, theoretically, take away the variable of socioeconomic status, which can oftentimes be a confounding factor.

NATFAN

The following information was taken from the Institute for Obesity Research and Program Evaluation website on May 2, 2013 [14]:

> *In 2009, the WIC food benefits were revised, representing the first substantial modification of the food package since the initiation of WIC in the early 1970s.*
>
> *The National Food and Nutrition (NATFAN) questionnaires are food choice and frequency instruments developed specifically for WIC participants. Three 33-item questionnaires (Women, Infant, and Child) provided the basis for a national multi-year, multi-level study to examine participant food and nutrition behavior before and after implementation of the revisions in the WIC food package.*
>
> *Using a repeated cross-sectional design, the NATFAN study involved state, territorial, tribal, and local WIC programs in an assessment of the impact of the WIC food package benefit revisions. The WIC foods package revisions were designed to align the WIC food benefit with the Dietary Guidelines for Americans and the American Academy of Pediatrics' current dietary guidance for feeding infants. The primary goals of the revisions were to encourage consumption of fruits, vegetables and whole grains; to lower saturated fat intake; and to promote the establishment of long-term breastfeeding.*
>
> *Highlights of the food package revisions include:*
>
> - *Inclusion of fruits and vegetables*

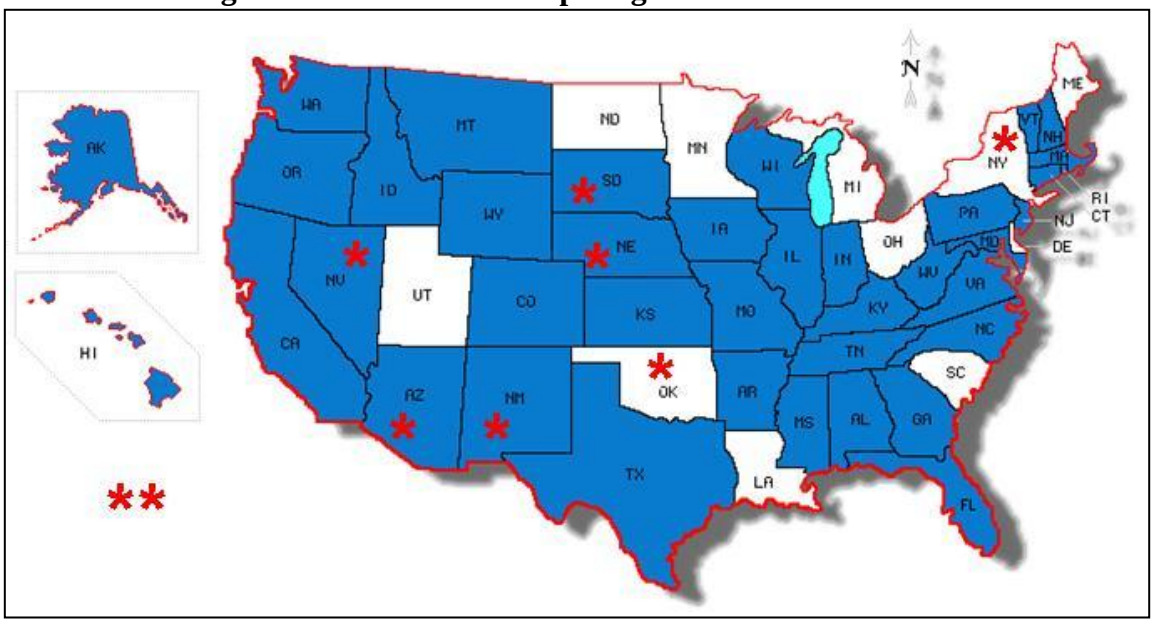
- *Inclusion of whole grain items such as whole wheat bread, oatmeal, brown rice, and tortillas –(both corn & whole wheat)*
- *Increased amounts of food available to women and their infants who are exclusively breastfeeding*
- *Exclusion of whole milk for recipients over 2 years of age*
- *Expansion of commercial baby foods available for infants*
- *Availability of soy milk and tofu as options to accommodate cultural food preferences*

WIC participants from 38 states, 10 Indian Tribal Organizations (ITOs), Washington DC, and one US Territory (50 WIC programs) participated in the NATFAN survey in Fiscal Year (FY) 2009 prior to the implementation of the new food package.

Following the revisions to the food package in late FY 2010 and early FY 2011 (at least 6 months after implementation), 40 states, 16 ITOs, Washington DC, and one US Territory (58 WIC programs) re-administered the NATFAN questionnaires to WIC participants.

Figure 1 illustrates the states and territories that participated in the NATFAN post survey.

Figure 1: NATFAN Participating States and Territories



http://orin.tamu.edu/research/natfan/

ERS Food Desert Mapping

This thesis also utilizes the USDA's (ERS division) data on food deserts to determine which participating WIC clients reside in food desert zip codes. The USDA defines a food desert as a census tract in which at least 33 percent of the tract's population or a minimum of 500 people in the tract must have low access to a supermarket or large grocery store [(15)]. A census tract is a "small, relatively permanent statistical subdivision of a county" [(16)]. They are "designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions, and average about 4,000 inhabitants" ([(16)]. Food desert areas share some common characteristics such as: larger percentages of individuals without a high school degree or GED, higher individual and family poverty rates, lower median family

incomes, greater percentages of residents living in sparsely populated areas outside cities, larger shares of people who are older and higher numbers of small grocery and convenience stores per capita [4].

The issue of greatest concern for residents of food deserts is the lack of access to nutritious food. People who reside in food deserts often have no option but to rely on smaller stores where prices are higher and the quality and variety of fresh food is more limited [5]. This research aims to determine if living in a food desert is associated with the consumption of fruits, vegetables or whole grains.

2. REVIEW OF THE LITERATURE

Fruits and Vegetables

Fruits and vegetables are sources of complex carbohydrates, dietary fiber, vitamins and minerals [17]. Studies have found that a "habit of eating lots of fruits and vegetable beginning during childhood is a significant positive predictor of fruit and vegetable intake among adults" [17].

According to the 2010 Dietary Guidelines for Americans, there are three major reasons to support the recommendation for Americans to eat more fruits and vegetables.

> *"First, most vegetables and fruits are major contributors of a number of nutrients that are underconsumed in the United States, including folate, magnesium, potassium, dietary fiber, and vitamins A, C, and K. Second, consumption of vegetables and fruits is associated with reduced risk of many chronic diseases. Specifically, moderate evidence indicates that intake of at least 2 ½ cups of vegetables and fruits per day is associated with a reduced risk of cardiovascular disease, including heart attack and stroke. Some vegetables and fruits may be protective against certain types of cancer. Third, most vegetables and fruits, when prepared without added fats or sugars, are relatively low in calories. Eating them instead of higher calorie foods can help adults and children achieve and maintain a healthy weight"* [18].

Research suggests that "childhood eating patterns are important determinants of adult risk of certain diet-related cancers" [19]. Diets containing an abundant amount of fruits and vegetables have been shown to provide a protective effect against certain cancers such as cancer of the colon, breast, lung, oral cavity, larynx, esophagus, stomach, bladder, uterine cervix, and pancreas [20].

According to a 2011 study, vegetable intake may have a protective role in preventing overweight among children and adolescents [21], and 2012 systematic literature review found evidence that suggests high intakes of fruit protect against increasing obesity [22].

Research has also revealed the existence of a "socioeconomic gradient in fruit and vegetable consumption where, low income-education groups consume fruits and vegetables less often than the high income education group" [12]. It has been suggested that this disparity may be due to nutritional knowledge and awareness of risks and/or the high price of fruits and vegetables [12]. When children were interviewed regarding fruit intake, similar results were found [23]. Those in the high socioeconomic status group consumed more fruit on average [23]. Socioeconomic status and diet will be expounded upon in further detail in a subsequent section.

After the WIC food package changes in 2009, WIC children now receive $6.00 per month in cash value-vouchers for fresh fruits and vegetables [24]. This corresponds to approximately 8 pounds of fresh produce, or 1-2 servings per day [24]. This amount is not adequate to meet the daily requirements of 2 cups of fruit and 2.5 cups of vegetables

per day, however, WIC is meant to be a supplemental nutrition program, not a sole nutrition source.

Whole Grains

In the United States market place, consumers have a wide variety of grain based options and, therefore, generally meet the recommended amount for total grains [18]. Most of the grains Americans consume, however, are refined rather than whole grains [18].

Table 3: Whole Grains

Grain Type	What it is	Example
Whole grain	Consists of 3 components – the bran, germ, and endosperm.	Buckwheat, bulgur, millet, oatmeal, quinoa, rolled oats, brown or wild rice, whole grain barley, whole rye, and whole wheat
Refined grains	Have been milled to remove the bran and germ from the grain. Improves texture and shelf life, but also removes dietary fiber, iron and many B vitamins	White flour, de-germed cornmeal, white bread, white rice
Enriched grains	Grain products with B vitamins (thiamin, riboflavin, niacin, folic acid) and iron added. Refined grains are usually enriched	Enriched bread and white rice

Dietary Guidelines for Americans, 2010

Whole grains, described in detail in Table 3, contain many bioactive compounds, which play a protective role against certain disease states [25]. The Dietary Guidelines for Americans 2010 also gives reasons to support their recommendation of consuming more whole grains.

> "*Whole grains are a source of nutrients such as iron, magnesium, selenium, B vitamins, and dietary fiber. Whole grains vary in their dietary fiber content. Moderate evidence indicates that whole grain intake may reduce the risk of cardiovascular disease and is associated with a reduced incidence of type 2 diabetes. Consuming enough whole grains helps meet nutrient needs. Choosing whole grains that are higher in dietary fiber has additional health benefits"* [18].

Table 4: USDA My Plate Recommendations for Whole Grains

Age	Recommendation
2-3 years old	3 ounce equivalents
4-8 years old	5 ounce equivalents

Choosemyplate.gov

National Health and Nutrition Examination Survey data indicates that children and adolescents are consuming far below the recommended amounts of whole grains, which are listed in Table 4 [26].

A research study done by O'Neil and associates showed that, although overall consumption of whole grains among children aged 2-18 was low, those who consumed the most serving of whole grains had better diet quality and nutrient intake [27].

A 2012 systematic literature review determined that high intake of whole grains protects against increasing obesity [22].

A cross sectional mail survey from 1993 to 1996 was used to determine the top sources of whole grains for Americans and their contribution to the intakes of B vitamins including thiamin, riboflavin, niacin, vitamin B6, and folic acid [25]. The study determined that the top source of whole grains were wheat/rye bread followed by popcorn and cooked cereals [25]. They also found that grain foods made a large contribution to the daily intakes of thiamin (30.2-45.9% daily recommended amount), riboflavin (23.1-29.2%), niacin (27.1-35.8%), vitamin B6 (22.9-27.5%), and folic acid (23.3-27.7%) [25].

Obesity: Diet and the WIC program

Energy density of an individual's diet can be a good indication of the overall quality of the diet [28]. Studies have shown that diets high in whole grains, and fresh vegetables and fruit have a low energy density and high vitamin and mineral content [28,29]. In some studies energy density of the individual's diet was an independent predictor of obesity and the metabolic syndrome [30]. Findings from NHANES have consistently shown an insufficient consumption of fruits and vegetables among children in the US [17,31].

According to the 1999-2002 NHANES data, the prevalence of overweight among children aged 2 through 5 years is 10%, which is double the rate reported two decades ago [32]. Results of a 2003 New York WIC study revealed that 38% of children included in the survey were overweight or at risk of overweight [32].

Diet and Socioeconomic Status

The term socioeconomic status (SES) refers to the socially derived economic factors that influence what positions individuals or groups hold within the multiple-stratified structure of a society [33]. There are three important purposes for measuring SES in health research, the first being to describe and monitor the social distribution of a disease in order to inform health policy [33]. The second is to explain the causal mechanisms through which SES generates health differences, and the third and most important to this particular thesis is to statistically adjust for socioeconomic circumstances when another exposure is the main focus of interest [33].

A large amount of research supports the idea that diet quality, and subsequently obesity and type 2 diabetes, follows a socioeconomic gradient [34]. "The burden of disease falls disproportionately on people with limited resources, ethnic minorities, and the poor" [34]. Higher quality diets are associated with higher SES, while energy dense, nutrient poor diets are preferentially consumed by people of lower SES [35]. Whole grains, fresh vegetables and fruit are more likely to be consumed by groups of higher SES [35]. Likewise, families of lower socioeconomic status, compared with more

affluent households, are less likely to eat healthy foods and more likely to overcome total fat and saturated fat [36].

Food Deserts

According to a 2013 CDC study, there are 6 major community-level barriers affecting access to fruit and vegetables: cost, transportation, quality, variety, changing food environment, and changing societal norms [37]. Cost was the most commonly cited barrier among all focus groups and transportation was second [37].

The Chicago Policy Research Team explains why food deserts exist in their report titled *Deserted*:

> "*Today's food deserts are the result of the compounded problems of politics, public policies, and social institutions, which intentionally or unintentionally resulted in the ultimate exclusion of populations from the crucial resources or representation necessary to ensure adequate access to food. Resulting from these failings, we find that food deserts represent an equilibrium outcome of two main factors: demand for and supply of healthy foods. Demand-side reasons, including residents' low income; high prices of healthy food options; low convenience in terms of food preparation; and cultural and taste preferences, all lead to low demand for healthy food and high demand for fast food in low-income neighborhoods. Supply-side reasons, including a small customer base; low neighborhood income; high operating expenses; high security risk and costs; at times ineffective public policy; and the lack of large*

contiguous space in the inner city, all lead to high costs to retailers and low supply of healthy food."[38]

Dean and Sharkey examined characteristics of the community food environment and fruit and vegetable intake for 2,556 urban and rural residents of the Brazos Valley, Texas selected through random digit dialing [39]. The study used a cross sectional design to measure fruit and vegetable intake and the researchers found that retail food environments have different impacts on fruit and vegetable intake in urban and rural settings, with distance being a major factor in rural settings [39].

Morton and Blanchard randomly surveyed more than 1,500 individuals in four non-metro counties in Iowa [4]. All four counties had four or fewer small grocery stores and no large food retailer or supercenter [4]. The authors used ARCVIEW geographic information system mapping software to identify populations that reside within a given distance from supermarkets and supercenters [4]. They uncovered 4 distinct challenges for residents: A large share did not consume adequate amounts of fresh fruits, nearly two-thirds did not consume adequate amounts of vegetables, more than one-third lacked adequate dairy in their diet, and more than one-fourth lacked the recommended levels of protein in their diet [4].

Coveney and O'Dwyer's recruited 16 households without cars, 6 of which lived in food deserts [5]. Using in-depth interviews they found that living in a food desert did not alone impose food access difficulties [5].

Walker and colleagues identified 31 studies that analyzed food deserts [3]. They found that these 31 studies utilized 9 measures to assess food access and can be

summarized in four categories: Access to supermarkets, Racial/ethnic disparities in food deserts, socioeconomic status in food deserts, differences in chain versus non-chain stores [3]. The review concluded that further research on the topic of food deserts is warranted.

Pearson and colleagues performed a cross-sectional study by randomly selecting 1000 electoral roll addresses equally distributed between four electoral wards [40]. These wards (2 urban and 2 rural) were chosen to reflect diversity in grocery shopping facilities, material derivation and level of urbanization [40]. All addresses were sent a questionnaire, which collected information on family demographics, supermarket and shop use, car ownership and mobility. Previous day's frequency of fruit and vegetable intake was measured using a simple 24-hour recall question that recorded the number of portions of fruit, and servings of vegetables eaten per day [40]. These data suggest that the three key elements of a food desert, fruit and vegetable rice, socio-economic deprivation and a lack of locally available supermarkets were not factors influencing fruit or vegetable intake [40].

Rose and Richards conducted a secondary data analysis using the 1996-97 National Food Stamp Program Survey [41]. The survey employed a 1-week food inventory method, including two at-home interviews, to determine household food use [41]. Separate linear regression models were developed to analyze fruit and vegetable use [41]. Independent variables included distance to store, travel time to store, ownership of a car and difficulty of supermarket access [41]. All models controlled for a full set of socio-economic variables [41]. The authors found that environmental factors are importantly

related to dietary choice in a nationally representative sample of low income households, reinforcing the importance of including such factors in interventions that seek to effect dietary improvements [41].

The CARDIA study by Boone-Heinonen and colleagues used 15 years of longitudinal data from the coronary artery risk development in young adults (CARDIA) study with linked time varying geographic information system-derived food resource measures [42]. The authors used repeated measures from 4 examination periods (n=15,854 person-examination observations) and conditional regression to model fast food consumption, diet quality, and adherence to fruit and vegetable recommendations as a function of fast food chain, supermarket, or grocery store availability within less than 1.0 km, 1.00 to 2.99 km, 3.00 to 4.99 km, and 5.00 to 8.05 km of respondents' homes [42]. Models were sex stratified, controlled for individual socio-demographic characteristics and neighborhood poverty, and tested for interaction y individual-level income [42]. They found that fast food consumption was related to fast food availability among low income respondents, particularly within 1.00 to 2.99 km of home among men [42]. Greater supermarket availability was generally unrelated to diet quality and fruit and vegetable intake, and relationships between grocery store availability and diet outcomes were mixed [42]. Findings provide some evidence for zoning restrictions on fast food restaurants within 3 km of low-income residents but suggest that increased access to food stores may require complementary or alternative strategies to promote dietary behavior change [42].

A study by Morland found that with each additional supermarket in a census tract, fruit and vegetable consumption among black residents increased by 32% [43].

WIC – Changing Food Environments

With nearly 49,000 authorized retailers nationwide, the policy change that added fruits and vegetables to the WIC food packages in 2009 had the potential to expand neighborhood produce availability [44].

A 2011 study assessed the impact of the WIC food package revisions and the findings demonstrated increases in daily fruit, vegetable and whole grain consumption by children aged 1-4 years [45].

Recent studies have reported on how implementation of the new healthier WIC food packages affected access of low income populations to healthy foods such as whole grains, fruits and vegetables [36]. Interestingly multiple studies found that the food package changes "significantly improved availability and variety of healthy foods in WIC-authorized and (to a smaller degree) non-WIC convenience and grocery stores" [36]. Overall, the availability and selection of commonly consumed fresh fruits and vegetables improved after the food package change [44]. The conclusions were that the WIC food package revisions have not only improved access to healthy foods for WIC participants but also to society as a whole [36].

Findings from a 2011 study suggest that "(1) large vendors that previously did not offer fresh fruits and vegetables (e.g., mass merchandise stores) added fresh fruits and vegetables; (2) WIC vendors expanded stocking of culturally specific FV to attract

such customers; and (3) small vendors and pharmacies met WIC stocking requirements by stocking canned/frozen forms of vegetables" [44].

From January 2009 to January 2010, 45 corner stores in Harford, Connecticut were inventoried and data on availability and variety of fresh fruits, fresh vegetables, whole grains, and lower fat milk were recorded [46]. It was discovered that WIC certified vendors "carried more varieties of fresh fruit, a greater variety of lower fat milk, and had greater availability of whole grain bread and brown rice than vendors without WIC authorization after the policy change" [46]. For those stores without WIC authorization, there was no significant increase in availability of these foods [46].

3. RESEARCH QUESTIONS

In order learn about the impact of food deserts on the NATFAN survey participants, the research questions listed in Table 5 were designed and analyzed.

Table 5: Research Questions and NATFAN

Research Question	***NATFAN Survey Question to be analyzed***
RQ1: Is living in a food desert associated with the frequency of fruit consumption?	Question 75
RQ2: Is living in a food desert associated with the variety of fruit consumed?	Question 85
RQ3: Is living in a food desert associated with the frequency of vegetable consumption?	Question 76
RQ4: Is living in a food desert associated with the variety of vegetables consumed?	Question 86
RQ5: Is living in a food desert associated with the frequency of whole grain consumption?	Questions 78, 79, and 80
RQ6: What percentage of the western region WIC participants reside in food deserts?	Participant Zip Codes

4. MATERIALS AND METHODS

Institutional Review Board

The proposed study has been approved by the Institutional Review Board (IRB) at Texas A&M University (College Station, TX).

Databases

This research study used existing data (i.e. secondary data) to analyzed the fruit, vegetable and whole grain consumption of child WIC participants from the Western USDA region (Arizona, California, Nevada, Oregon and Washington) who participated in the NATFAN survey following implementation of the new WIC food packages (i.e. the post survey). It then compared the consumption of these foods with the participants' locations and examined consumption for children residing and not residing in food deserts, utilizing the USDA's food desert data to identify which participants are located in food deserts. The western region of the United States was chosen because it includes states with diverse ethnic composition and is represented by a large number of responses for children whose parents participated in the NATFAN survey. Included in the western region are Arizona, California, Nevada, Oregon and Washington. Alaska, Hawaii and Commonwealth of the Northern Mariana Islands have been excluded because the USDA data does not include these states, and the western region Indian tribes have been excluded in order to decrease confounding factors. The goal of the study was to collect data on food deserts rather than do a pre-post analysis, therefore only one portion of the

NATFAN survey was needed for the analysis. The post portion was chosen over the pre, merely because it was the more recent data of the two. The initial analysis of the western region post data shows that there are approximately 5000 child surveys in which the zip codes have been included.

For the NATFAN survey, The Institute for Obesity Research and Program Evaluation at Texas A&M University collaborated with Texas WIC, the National WIC Association staff and members of the NWA Research and Evaluation Committee, and USDA staff to conduct a national multi-year study regarding WIC participant food and nutrition behavior before and after the WIC food package changes.

The following questions (Table 6) from the post portion of the NATFAN survey were utilized:

Table 6: NATFAN Questions Utilized

Number	Question
75	How often does your child do the following? Eat fruit. This does not include juice.
76	How often does your child do the following? Eat vegetables such as salad, carrots, or sweet potatoes. This does not include potatoes, French fries, or potato chips.
78	How often does your child do the following? Eat whole-wheat tortillas.
79	How often does your child do the following? Eat whole-wheat or whole grain bread.
80	How often does your child do the following? Eat brown rice.
85	During the past year, which fruits did your child usually eat?
86	During the past year, which vegetables did your child usually eat?
96	What is your zip code?

To discover which participating WIC clients reside in food deserts, we relied on data obtained by the U.S. Department of Agriculture Economic Research Service (ERS/USDA). Known as the "Food desert locator," the system uses census tracts and distance to nearest source of healthy foods to measure whether or not an area is considered a food desert [15]. A census tract is a small, relatively permanent subdivision of a county that generally contains between 1,000 to 8,000 people, with an optimum size of 4,000 people [47]. Census tracts are used rather than zip codes or other indicators because they tend to have economically homogeneous populations [47]. To be considered a food desert, at least 33 percent of the census tract's population or a minimum of 500 people in the tract must have low access to a supermarket or large grocery store [15].

The USDA food desert data uses census tracts rather than zip codes, and therefore needed to be converted to zip codes in order to compare it with NATFAN results. To do this, the Missouri Data Center's MABLE/Geocorr2K: Geographic Correspondence Engine with Census 2000 Geography was utilized [48]. This engine converts the census tracts to zip codes for each state.

Analytic Methods

Once in the proper format (zip codes versus census tracts), the USDA data was matched with the NATFAN data. IBM SPSS Statistics 21 was utilized to answer the aforementioned research questions. The subsample size for all analyses was large (N = 4,227).

The first analytical method performed involved descriptive data analyses to determine the demographic characteristics of the study population as well as which participants resided in food desert zip codes.

To test the hypothesis, separate two-sample t-tests were conducted to determine if the mean difference between frequencies of fruit, vegetable, and whole grain consumption equaled zero. A t-test was used because its purpose is to examine two population means, rather than an ANOVA (analysis of variance), which is used to test the means of more than two groups. A two sample t-test examines whether two samples are different (in the case of this study, FDR versus NFDR) and is commonly used when the variances of two normal distributions are unknown. The test statistic in the t-test is known as the t-statistic, and is used along with the t-distribution and degrees of freedom (df) to determine a p value (probability) that can be used to determine whether the population means differ. A t-test was also used to determine if the mean difference between varieties of fruit and vegetables consumed equaled zero. A confidence level of 99% was set to limit to affect of multiple inference.

> "*Recognize that any frequentist statistical test has a random chance of indicating significance when it is not really present. Running multiple tests on the same data set at the same stage of an analysis increases the chance of obtaining at least one invalid result* [(49)]*."*

A 99% confidence interval is based on the p-value (α), which is the probability of the observed effect. The smaller the p-value, the greater the evidence of change. The confidence level is 100x(1-(p-value)), therefore, the confidence level for a 99%

confidence interval is 0.01. The degrees of freedom for a two sample t-test is n-2, where n is the total of FDR and NFDR participants, which comes out to 4,225.

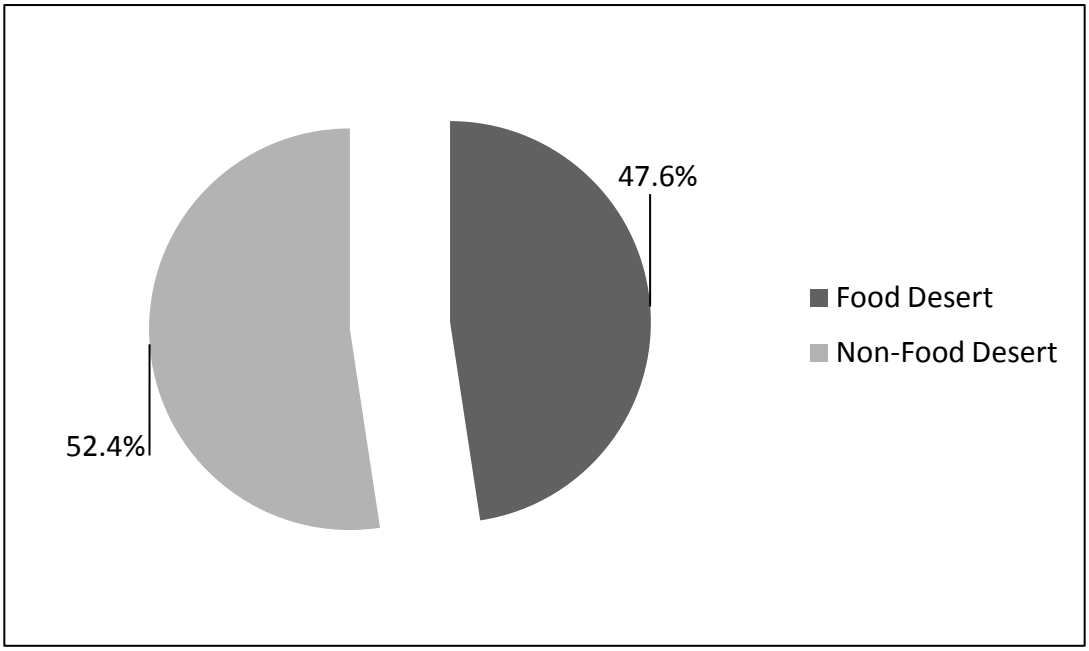
To determine the mean consumption amounts of fruit, vegetables, and whole grains, descriptive data was utilized and organized into frequency tables. This method was also used to determine the most commonly consumed fruits and vegetables.

5. RESULTS

Once the USDA and NATFAN data sets were merged, an analysis was performed using SPSS statistical analysis software. 24 cases with incomplete zip codes were deleted, and the remaining total number of surveys was 4,227.

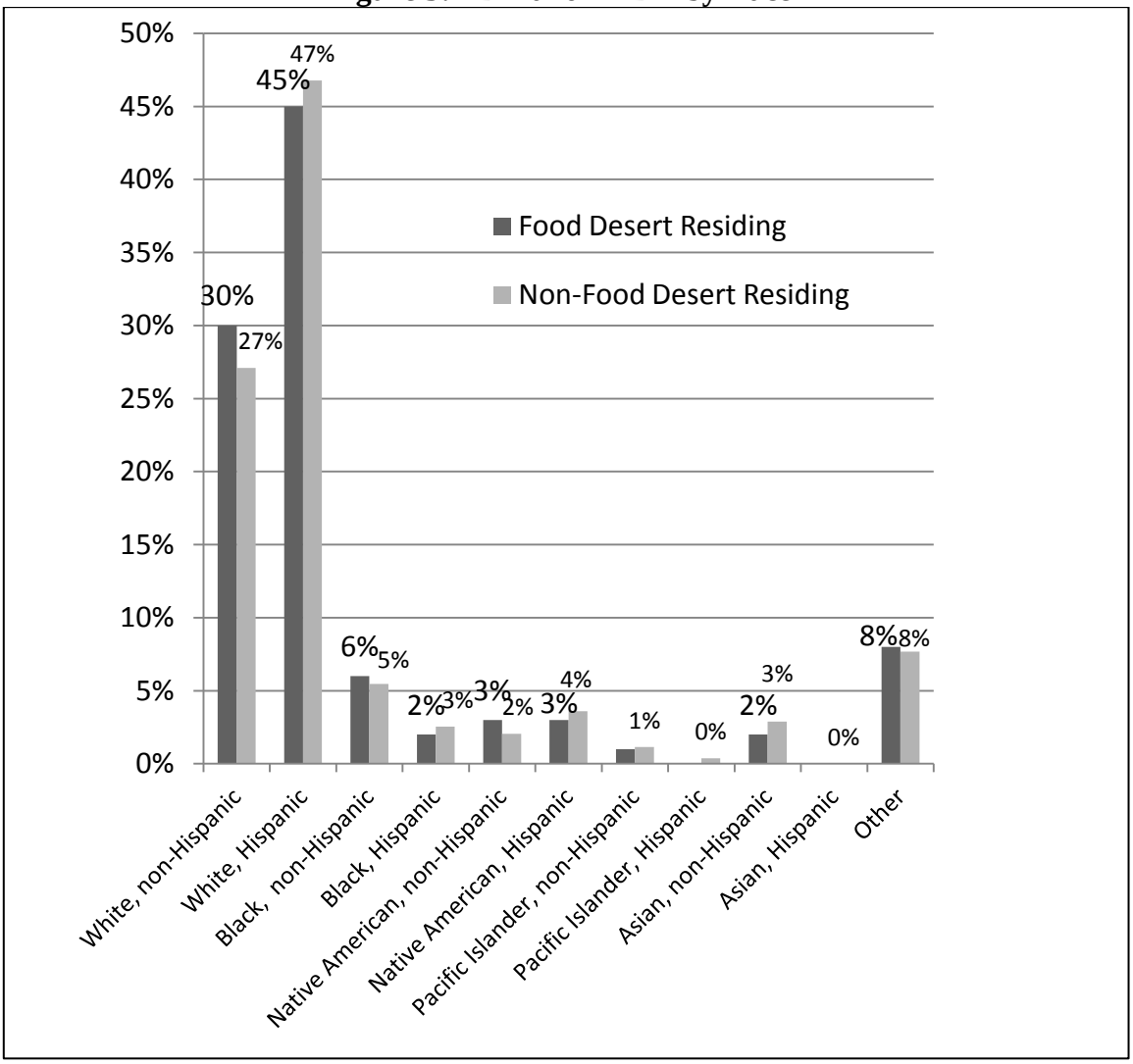
The number of FDR and NFDR participants was compared using question 96 of the NATFAN survey. 47.6% of survey participants reside in food desert zip codes. The results are described in Figure 2.

Figure 2: FDR and NFDR Percentages



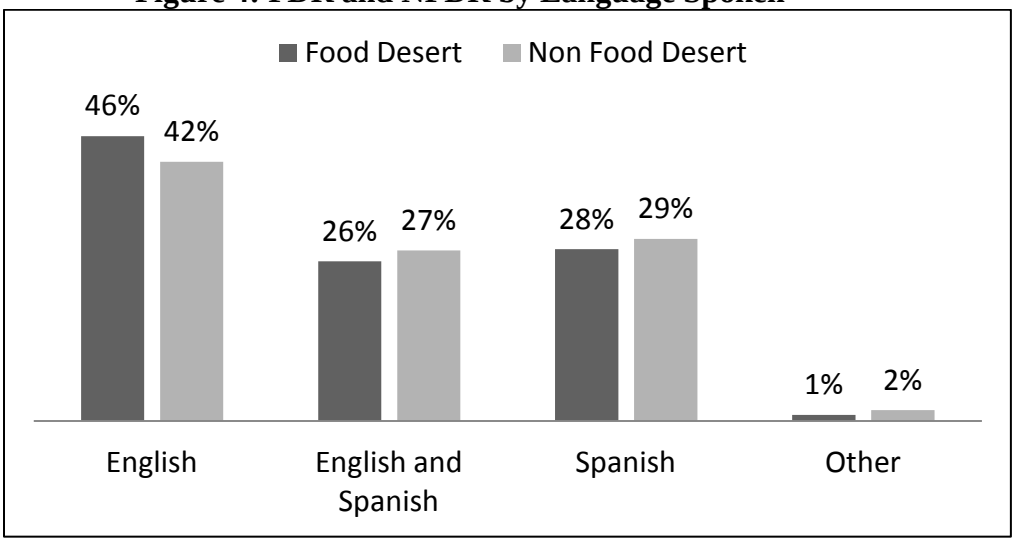
Question 98 on the NATFAN survey regarding race was analyzed for both FDR and NFDR participants. Of both the FDR and NFDR participants, the majority were White, Hispanic. The breakdown is described in more detail in Figure 3.

Figure 3: FDR and NFDR by Race



Question 97 on the NATFAN survey regarding language spoken most often at home was also analyzed. The results were also similar between groups with English being the most commonly spoken language. The results are summarized in the Figure 4.

Figure 4: FDR and NFDR by Language Spoken



A t-test was performed to compare food desert residing (FDR) WIC participating children (WPC) against non-food desert residing (NFDR) WPC with the confidence level set at 99%. More specifically, their consumption of the following items was compared: fruit, vegetables and whole grains. The results from the analyzed data in Table 7 show the following significance levels for each category of food.

Table 7: T-Test Significance levels of Fruit, Vegetables, and Whole Grains

CONSUMPTION	SIGNIFICANCE	SIGNIFICANT
Fruit (frequency)	.087	No
Fruit (variety)	.139	No
Vegetable (frequency)	.082	No
Vegetable (variety)	.172	No
Whole Grains	.005*	Yes

$\alpha = .01$

Results, as shown in the above table, suggest that there was no significant difference in fruit, fruit juice, or vegetable consumption between FDR and NFDR child WIC participants. Question 75 and 76, regarding fruit and vegetable consumption respectively, were analyzed and the following two tables (Tables 8 and 9) summarize the overall results.

Table 8: Fruit Consumption Frequency

How Often Fruit is Consumed	Total Population of Survey
Never or less than 1 time per week	1.9%
1-3 times per week	9.4%
4-6 times per week	15.2%
1 time per day	15.4%
2 times per day	29.5%
3 times per day	18.6%
4 or more per day	10%

Table 9: Vegetable Consumption Frequency

How Often Vegetables are Consumed	Total Population of Survey
Never or less than 1 time per week	4.0%
1-3 times per week	16.3%
4-6 times per week	16.1%
1 time per day	20.5%
2 times per day	24.0%
3 times per day	12.8%
4 or more per day	6.3%

The NATFAN survey does not provide consumption data, however it does provide information on frequency of consumption. It was interesting to attempt to identify a possible relationship between frequency of consumption and actual consumption. Assuming each time fruit and vegetables are consumed is equal to 1 cup, only 58.1% of children in the survey are meeting the recommended 2 cups of fruit per day, and only 19.1-43.1% (using 2 times per day and 3 times per day am) are are meeting the recommendation of 2.5 cups of vegetables per day.

The most commonly consumed fruits by survey participants were bananas, apples, and oranges (Figure 5). The nutrient composition of these 3 fruits are listed in Table 10.

Figure 5: Most Commonly Consumed Fruits

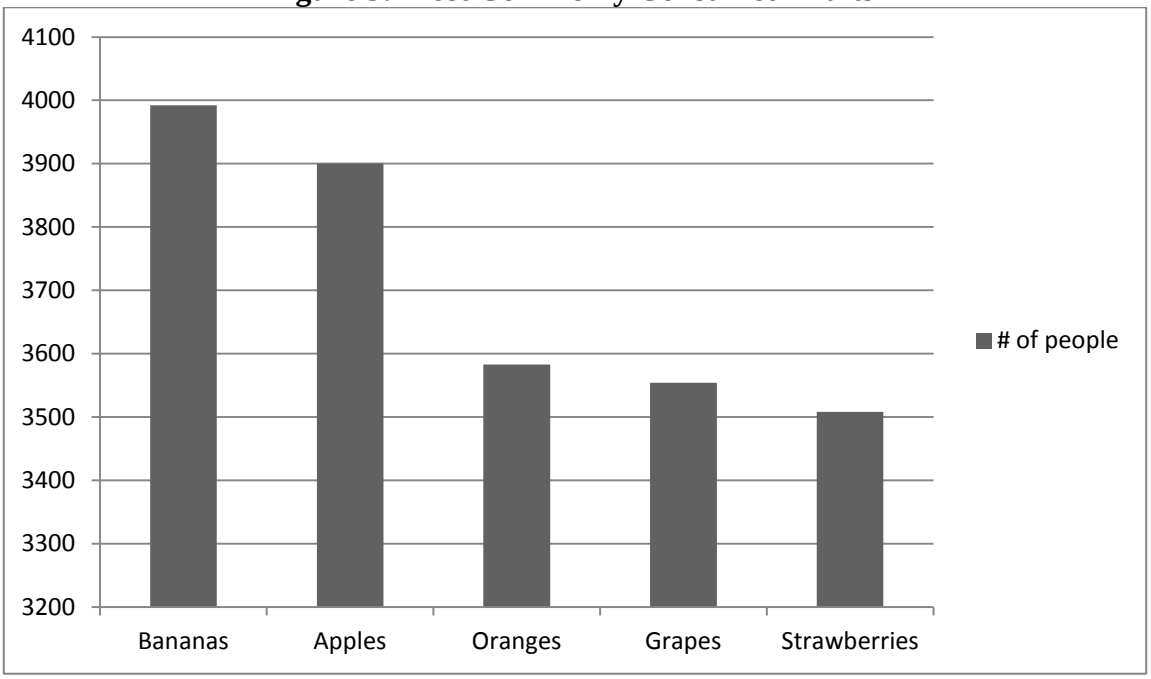


Table 10: Nutrient Analysis of Bananas, Apples, and Oranges

Nutrient	Units	Banana (1 cup)	Apple (1 cup)	Orange (1 cup)	DRI Children Aged 1-8 (53)
Proximates					
Water	g	112.36	93.26	141.85	1.3-1.7 L/d
Energy	Kcal	134	57	81	
Protein	g	1.64	0.28	1.50	13-19
Total lipid (fat)	g	0.50	0.19	0.25	
Carbohydrate	g	34.26	15.05	20.69	100-130
Fiber, total dietary	g	3.9	2.6	3.6	19-25
Sugars, total	g	18.34	11.33	14.02	
Minerals					
Calcium, Ca	mg	8	7	71	700-1000
Iron, Fe	mg	0.39	0.13	0.21	7-10
Magnesium, Mg	mg	40	5	18	80-130
Phosphorus, P	mg	33	12	38	460-500
Potassium, K	mg	537	117	274	3000-3800
Sodium, Na	mg	2	1	2	1000-1200
Zinc, Zn	mg	0.22	0.04	0.13	3-5
Vitamins					
Vitamin C	mg	13	5	97.5	
Thiamin	mg	0.047	0.019	0.112	0.5-0.6
Riboflavin	mg	0.109	0.028	0.084	0.5-0.6
Niacin	mg	0.998	0.099	0.701	6-8
Vitamin B-6	mg	0.55	0.045	0.130	0.5-0.6
Folate, DFE	µg	30	3	56	150-200
Vitamin A, RAE	µg	4	3	20	300-400
Vitamin E	mg	0.15	0.20	0.25	6-7
Vitamin K	µg	0.8	2.4	0	30-55

The most commonly consumed vegetables by survey participants were carrots, potatoes, and corn (Figure 6). The nutrient composition of these 3 vegetables is listed in Table 11.

Figure 6: Most Commonly Consumed Vegetables

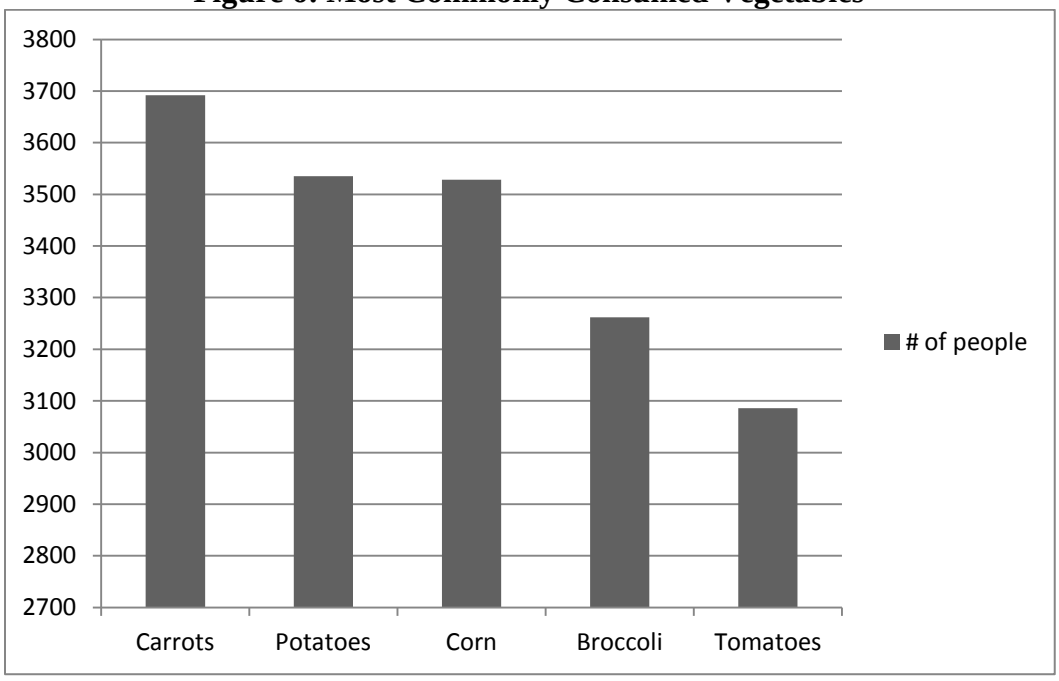


Table 11: Nutrient Analysis of Carrots, Potatoes, and Corn

Nutrient	Units	Carrots (1 cup)	Potatoes (1 cup)	Corn (1 cup)	DRI Children Aged 1-8
Proximates					
Water	g	113.01	119.01	17.21	1.3-1.7 L/d
Energy	Kcal	52	116	606	
Protein	g	1.19	3.03	15.64	13-19
Total lipid (fat)	g	0.31	0.14	7.87	
Carbohydrate	g	12.26	26.20	123.27	100-130
Fiber, total dietary	g	3.6	3.3	12.1	19-25
Sugars, total	g	6.07	1.17	1.06	
Minerals					
Calcium, Ca	mg	42	18	12	700-1000
Iron, Fe	mg	0.38	1.17	4.50	7-10
Magnesium, Mg	mg	15	34	211	80-130
Phosphorus, P	mg	45	86	349	460-500
Potassium, K	mg	410	632	476	3000-3800
Sodium, Na	mg	88	9	58	1000-1200
Zinc, Zn	mg	0.31	0.44	3.67	3-5
Vitamins					
Vitamin C	mg	7.6	29.6	0.0	
Thiamin	mg	0.084	0.12	0.639	0.5-0.6
Riboflavin	mg	0.074	0.048	0.334	0.5-0.6
Niacin	mg	1.258	1.581	6.021	6-8
Vitamin B-6	mg	0.177	0.442	1.033	0.5-0.6
Folate, DFE	µg	24	24	32	150-200
Vitamin A, RAE	µg	1069	0	18	300-400
Vitamin E	mg	0.84	0.02	0.81	6-7
Vitamin K	µg	16.9	2.8	0.5	30-55

(50)

The most commonly consumed fruits and vegetables, listed in Table 10 and 11, are sources of many vitamins and minerals including potassium, magnesium and vitamins A, C, and K. According to the survey results, participants are under consuming fruits and vegetables and possibly missing out on these vital nutrients.

Although no difference was found between FDR and NFDR fruit and vegetable consumption, there was a significant difference in the whole grain intake of NFDR and FDR participants (see Table 7).

Analyzing the whole grain questions individually (brown rice, whole wheat tortillas, and whole wheat bread) using a t-test showed the following significance levels:

Table 12: T-Test Significance Levels for Whole Grains

CONSUMPTION	SIGNIFICANCE	SIGNIFICANT
Brown Rice	.000*	Yes
Whole Wheat Tortillas	.016	No
Whole Wheat Bread	.920	No

$\alpha = .01$

Results, as shown in the above Table 12, suggest that there was no significant difference in whole wheat bread or whole wheat tortilla consumption between FDR and NFDR child WIC participants. The following tables describe the overall results of whole wheat bread (Table 13) and whole wheat tortilla consumption (Table 14).

Table 13: Whole Wheat Bread Consumption Frequency

How Often Whole Wheat Bread is Consumed	Total Population of Survey
Never or less than 1 time per week	12.9%
1-3 times per week	30.9%
4-6 times per week	20.2%
1 time per day	21.9%
2 times per day	10.4%
3 times per day	2.5%
4 or more per day	1.2%

Table 14: Whole Wheat Tortilla Consumption Frequency

How Often Whole Wheat Tortillas are Consumed	Total Population of Survey
Never or less than 1 time per week	63%
1-3 times per week	23.2%
4-6 times per week	3.8%
1 time per day	7.2%
2 times per day	2.1%
3 times per day	0.5%
4 or more per day	0.2%

There was, however, a significant difference in the brown rice intake of NFDR and FDR participants. Corresponding percentages for consumption of brown rice are listed in Table 15.

Table 15: Brown Rice Consumption Frequency - FDR vs. NFDR

How Often is Brown Rice Consumed	Non- Food Desert Population	Food Desert Population
Never or less than 1 time per week	55.4%	60%
1-3 times per week	29.7%	27.8%
4-6 times per week	6.0%	5.0%
1 time per day	6.4%	4.5%
2 times per day	1.5%	1.5%
3 times per day	0.7%	0.4%
4 or more per day	0.3%	0.2%

Examining the absolute percentage values, a greater percentage of NFDR participants were consuming brown rice 1or more times per week and 4 of more times per week compared to the percentages of FDR participants.

As discussed in detail in the literature review section, whole grains, including brown rice, can provide many vital nutrients to a child's diet. Table 16 summarizes the nutrient analysis of brown rice [50,51].

Table 16: Nutrient Analysis of Brown Rice

Nutrient	Units	Brown Rice (1 cup) (49)	DRI Children Aged 1-8 (53)
Proximates			
Water	g	19.18	1.3-1.7 L/d
Energy	Kcal	684	
Protein	g	14.69	13-19
Total lipid (fat)	g	5.4	
Carbohydrate	g	142.89	100-130
Fiber, total dietary	g	6.5	19-25
Sugars, total	g	1.57	
Minerals			
Calcium, Ca	mg	43	700-1000
Iron, Fe	mg	2.72	7-10
Magnesium, Mg	mg	265	80-130
Phosphorus, P	mg	616	460-500
Potassium, K	mg	413	3000-3800
Sodium, Na	mg	13	1000-1200
Zinc, Zn	mg	3.74	3-5
Vitamins			
Thiamin	mg	.742	0.5-0.6
Riboflavin	mg	.172	0.5-0.6
Niacin	mg	9.418	6-8
Vitamin B-6	mg	.942	0.5-0.6
Folate, DFE	µg	37	150-200
Vitamin A, RAE	µg	0	300-400
Vitamin E	mg	2.22	6-7
Vitamin K	µg	3.5	30-55

As mentioned in previous sections, the USDA recommends 3-5 ounce equivalents of whole grain per day for children 2-8 years of age. A 1 ounce equivalent is equal to 1 slice of bread, ½ cup cooked rice, or 1 small tortilla. As with fruit and vegetable consumption, the NATFAN survey does not provide actual consumption data, only frequency data. Assuming that each time whole grains are consumed the amount is roughly equal to 1 ounce, the majority of children included in the survey, FDR and NFDR, are not meeting that recommended amount unless they are getting their whole grains from other sources (see Table 17).

Table 17: Whole Grains Frequency of Consumption

Frequency	Whole Wheat Bread	Brown Rice	Whole Wheat Tortillas
Never to 6 times per week	64%	92.3%	89.9%
1 time per day or more	36%	7.7%	10.1%

It is possible to suppose that the children who are not consuming whole grains may be instead consuming enriched grains. Although these products replace some of the B vitamins that are lost in the refining process, they are still lacking the fiber that is present naturally in whole grain products.

6. DISCUSSION

WIC Policy and Food Deserts

This study contributes to a growing amount of research on food deserts. Previous food desert research studies have not specifically used WIC participants in their comparisons; therefore our study population is unique.

Using t-tests with a 99% confidence interval ($\alpha = 0.01$) to test differences in means between two groups, this study found no difference in the means of FDR and NFDR fruit and vegetable consumption. This finding is reflected in recent studies mentioned in the literature review that discussed how the new WIC food package change has affected food availability. These articles have concluded that the WIC food package revisions have not only improved access to healthy foods for WIC participants but also to society as a whole [36]. More specifically, vendors that were not previously stocking fresh produce now are because fresh fruits and vegetables are now WIC approved.

This study did however find a difference in whole grain consumption, specifically brown rice, between FDR and NFDR participants. Participants residing in food deserts were found to be consuming less brown rice than their non food desert counterparts. This is an important finding because, as summarized in Table 16, brown rice is a good source of fiber, certain B vitamins, potassium and magnesium while also being low in sugars, sodium, and fat. Although the NFDR group consumed more brown rice than the FDR participants, and may be obtaining slightly more of these key nutrients as a result, both groups were actually under-consuming whole grain foods in general

(17% of recommended) and as a result were at risk for the nutrients that whole grains provide, unless these same nutrients were available from other foods they are consuming (not known).

Similarly to fruits and vegetables, a recent study found that WIC vendors also had an increase in availability of whole grain products with the food package change [46]. To summarize, these findings suggest that fruit, vegetables, and whole grains may be more accessible to those participants in food deserts than they once were. In 2010, WIC was servicing 9.17 million people [13]. When a program is that large, it is possible for a policy change to have an effect on the population at large. In this case, the WIC food package change may have decreased the consequence of the food desert.

Fruit, Vegetable, and Whole Grain Consumption

As previously mentioned, this research project also found that as a whole, the survey population is likely under consuming fruits, vegetables, and whole grains. The findings suggest that, assuming each time fruit and vegetables are consumed is equal to 1 cup, only 58.1% of children in the survey are meeting the recommended 2 cups of fruit per day, and only 19.1% are meeting the recommendation of 2.5 cups of vegetables per day. As for whole grains, assuming that each time whole grains are consumed the amount is roughly equal to 1 ounce, the majority of children included in the survey are not meeting the recommended amount of 3 ounces unless they are getting their whole grains from other sources other than the ones listed in the survey. If these findings regarding fruit, vegetable and whole grain intake are accurate, WIC participants may be

under consuming some very important nutrients that these foods provide such as fiber, potassium, and vitamin C. This also means they are missing out on the protective effects fruits, vegetables, and whole grains offer against obesity, heart disease, type 2 diabetes, and many types of cancer [18].

As mentioned in the "Methods" section, the consumption amounts for fruits, vegetables, and whole grains are merely estimates based off of average serving sizes. In comparison to the 2003-2004 NHANES data, 100% of children (2-5 years old) are meeting the requirements for fruit intake, while 44% are meeting the required vegetable intake, and 17% meet the recommended whole grain intake [8]. Comparing the results of this study with the NHANES data, it appears that this study may be underestimating consumption amounts for fruits, vegetables, and whole grains.

Possibly the largest obstacle to overcome when it comes to increasing consumption of fruits, vegetables and whole grains is identifying the reason they are not currently being consumed in their recommended amounts. If access and availability is not a factor, what is? It may be cost, taste, being aware of health benefits, or possibly all of these. More research is needed to determine the answer to this question.

Promoting Healthy Eating

Although the literature on food deserts is inconclusive and more research is needed, there are approaches that can be taken to reduce the impact of food deserts if they do in fact hinder healthy eating.

There are essentially five important factors when it comes to health promotion: Intrapersonal, interpersonal, institutional, community, and public policy (Figure 7) [52]. This discussion will focus on 3: intrapersonal, community, and public policy. This discussion will focus on three of these factors: intrapersonal, community and public policy.

Figure 7: An Ecological Model for Health Promotion [52]

(1) intrapersonal factors—characteristics of the individual such as knowledge, attitudes, behavior, self-concept, skills, etc. This includes the developmental history of the individual.
(2) interpersonal processes and primary groups—formal and informal social network and social support systems, including the family, work group, and friendship networks.
(3) institutional factors—social institutions with organizational characteristics, and formal (and informal) rules and regulations for operation.
(4) community factors—relationships among organizations, institutions, and informal networks within defined boundaries.
(5) public policy—local, state, and national laws and policies.

On an intrapersonal level, interventions to increase knowledge of individuals may include WIC education programs on the benefits of consuming fruits, vegetables, and whole grains.

At the community level, programs such as farmers' markets, community gardens, or mobile carts that sell produce would offer greater access to people residing in food deserts [53]. These programs are also easier and cheaper to implement than the incentive

programs for grocers [53]. Many state WIC programs currently allow vouchers to be exchanged at farmers markets. See appendix B for the complete list.

As far as public policy, certain approaches have been suggested at the state and federal level. Some states have begun using incentive programs to entice stores to begin offering more nutritious food, and to get food retailers to develop or expand stores [53]. These stores are sometimes unwilling to take the risk of offering these foods when there is uncertainty about whether they can sell enough of them [53]. These incentives range from financing for new large scale supermarkets, to small incentives offered to existing stores to stock healthier foods, such as gift cards at fruit and vegetable wholesalers [53]. The recent change in the WIC food packages may have an impact on the feasibility of increasing nutritious food options in small grocery stores and corner stores [53]. The new package may provide an increased and steady demand for these foods in stores in neighborhoods with high concentrations of WIC participants [53]. The results of a 2012 study indicated that following the WIC food package changes, WIC approved stores had more healthful food at baseline and saw a greater increase in the availability of healthful food during the study period than non WIC approved stores [54]. This indicates that the increased demand for healthful items due to WIC package changes led to more availability.

At the local level, governments could require that community planners systematically plan their community's food access the way they plan access to services and facilities like transportation, parks, hospitals, or schools [53]. Another way to increase access could be to improve public transportation routes [53]. This change could

be made by adding routes or offering a transportation subsidy to these low access people [53].

Project Assumptions and Limitations

For this project, certain assumptions have been made, and limitations exist. Firstly, it was assumed that all NATFAN zip codes not present within the USDA food desert data set are not food deserts. Also, it was assumed for this study that if a portion of a zip code lies within a food desert census tract, the entire zip code is a food desert. In reality, this may not be the case for certain zip codes.

A limitation of this study is that it does not represent the general population. WIC participants are low income and therefore, more likely to reside in food desert zip codes [3]. Also, analysis of zip codes, which is a big area with people of diverse incomes, makes it difficult to know what happened in pockets of poverty within the zip codes [47].

Another limitation of using the WIC population is that they are allotted certain amounts for specific foods such as fruits, vegetables and whole grains. For this reason, their consumption of these foods may not reflect the general public's consumption. Also, the WIC food packages may differ from state to state, therefore allowances for certain foods may vary (see appendix B) [55].

7. SUMMARY AND CONCLUSIONS

The evidence provided in this study shows a relationship between whole grain consumption and residing in a food desert area in WIC participants. However, there was not a significant relationship between fruit and vegetable consumption and living in a food desert. More research is needed is needed on the emerging concept of the food desert and whether or not it is associated with the eating habits of its inhabitants.

This research study also discovered that the majority of survey participants are likely not meeting the daily recommendations for fruit, vegetable, and whole grain consumption. Due to this finding, it is possible that the survey participants are under consuming the vital nutrients and fiber that are found in fruits, vegetables and whole grains. The reason for this under consumption is unknown and further research is needed to determine the cause so that steps can be taken to correct it.

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APPENDIX A

*NATFAN Questionnaire: Child, English**

FOOD & NUTRITION QUESTIONNAIRE

WIC is changing. We want to be better for you! We need information about your eating habits so we can better meet your needs.

Completing this survey is voluntary. Refusing to fill out the questionnaire will not affect your WIC status. Your answers will be kept confidential and anonymous.

FOOD & NUTRITION QUESTIONNAIRE

NATFAN - CHILDREN
(1 Year to under 5 Years)

How to Mark the Answers Correctly

- Make heavy marks that fill the circles completely.
- Erase cleanly any answer you wish to change.
- Make no stray marks.

CORRECT: ●

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PLEASE DO NOT WRITE IN THIS AREA

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CHILDREN

If you have a CHILD between the ages one and five years, please complete the next section.

68. How many cups of milk does YOUR CHILD *usually* drink in a day? *(Choose one only)*
1 cup = 8 oz

- ○ Less than 1 cup
- ○ 1 cup
- ○ 2 cups
- ○ 3 cups
- ○ 4 or more cups
- ○ **MY CHILD DOES NOT** drink milk

69. What kind of milk does YOUR CHILD drink most often? *(Choose one only)*

- ○ Cow's milk
- ○ Lactaid or lactose free milk
- ○ Soy milk
- ○ Goat's milk
- ○ Rice milk
- ○ **MY CHILD DOES NOT** drink milk

70. What type of cow's milk does YOUR CHILD drink most often? *(Choose one only)*

- ○ Whole milk
- ○ 2% milk
- ○ 1% milk
- ○ ½% milk
- ○ Skim (fat free) milk
- ○ **MY CHILD DOES NOT** drink cow's milk
- ○ **I DO NOT** know

How often does YOUR CHILD do the following?	NEVER OR LESS THAN ONCE PER WEEK	1 TO 3 TIMES PER WEEK	4 TO 6 TIMES PER WEEK	1 TIME PER DAY	2 TIMES PER DAY	3 TIMES PER DAY	4 OR MORE TIMES PER DAY
71. Drink 100% juice such as apple, orange, or tomato.	○	○	○	○	○	○	○
72. Drink soy milk.	○	○	○	○	○	○	○
73. Drink artificially sweetened drinks such as diet cola, diet soda, or Crystal Light®.	○	○	○	○	○	○	○
74. Drink sugar sweetened drinks such as Kool-Aid®, soda, cola, sport drinks, or sugar sweetened tea.	○	○	○	○	○	○	○
75. Eat fruit. This DOES NOT include juice.	○	○	○	○	○	○	○
76. Eat vegetables such as salad, carrots, or sweet potatoes. This DOES NOT include potatoes, French fries, or potato chips.	○	○	○	○	○	○	○

THE NEXT QUESTIONS ARE ABOUT GRAIN PRODUCTS.

How often does YOUR CHILD do the following?	NEVER OR LESS THAN ONCE PER WEEK	1 TO 3 TIMES PER WEEK	4 TO 6 TIMES PER WEEK	1 TIME PER DAY	2 TIMES PER DAY	3 TIMES PER DAY	4 OR MORE TIMES PER DAY
77. Eat corn tortillas.	○	○	○	○	○	○	○
78. Eat whole-wheat tortillas.	○	○	○	○	○	○	○
79. Eat whole-wheat or whole grain bread.	○	○	○	○	○	○	○
80. Eat brown rice.	○	○	○	○	○	○	○
81. Eat oatmeal.	○	○	○	○	○	○	○
82. Eat white bread.	○	○	○	○	○	○	○
83. Eat white flour tortillas.	○	○	○	○	○	○	○
84. Eat white rice.	○	○	○	○	○	○	○

85. During the *past year*, which fruits did YOUR CHILD *usually* eat?
(Choose all that apply - you can choose more than one)

- ○ Apples
- ○ Apricots (dried)
- ○ Apricots (fresh)
- ○ Bananas
- ○ Berries (blueberries, blackberries, raspberries)
- ○ Melons (cantaloupe, honeydew)
- ○ Cherries
- ○ Dates
- ○ Figs
- ○ Grapefruit
- ○ Grapes
- ○ Kiwis
- ○ Lemons or Limes
- ○ Mangos
- ○ Nectarines
- ○ Oranges
- ○ Papaya
- ○ Peaches
- ○ Pears
- ○ Pineapple
- ○ Plums
- ○ Prunes
- ○ Raisins
- ○ Rhubarb
- ○ Strawberries
- ○ Tangerines
- ○ Watermelon
- ○ Other (please specify) _____
- ○ **MY CHILD DOES NOT** eat fruit

86. During the *past year*, which vegetables did YOUR CHILD *usually* eat?
(Choose all that apply - you can choose more than one)

- ○ Asparagus
- ○ Avocados
- ○ Beets
- ○ Broccoli
- ○ Brussels Sprouts
- ○ Cabbage
- ○ Carrots
- ○ Cauliflower
- ○ Chayote
- ○ Corn
- ○ Cucumbers
- ○ Eggplant
- ○ Greens (collard, mustard, turnip)
- ○ Green Beans
- ○ Green Peas
- ○ Lettuce (all varieties)
- ○ Mushrooms
- ○ Okra
- ○ Onions
- ○ Peppers (bell, yellow, green, orange, or red)
- ○ Potatoes
- ○ Spinach
- ○ Summer Squash (yellow, zucchini)
- ○ Sweet Potatoes
- ○ Tomatoes
- ○ Tomatillos
- ○ Winter Squash (acorn, pumpkin)
- ○ Other (please specify) _____
- ○ **MY CHILD DOES NOT** eat vegetables

Please choose the best answer for each of the following statements:	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
87. I am willing to give MY CHILD who is two years or older 2% milk.	○	○	○	○	○
88. I am willing to give MY CHILD who is two years or older 1% milk.	○	○	○	○	○
89. I am willing to give MY CHILD who is two years or older skim milk (fat free).	○	○	○	○	○

90. Do YOU have a CHILD one year or older who receives WIC foods?
○ Yes ○ No

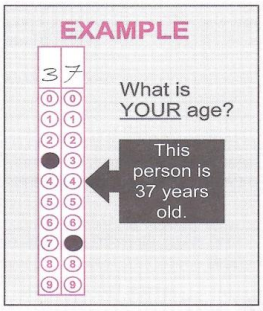
91. If YES, did YOUR CHILD receive WIC foods in the past 30 days?
○ Yes ○ No

92. Are you the PRIMARY CAREGIVER for this CHILD?
○ Yes ○ No

93. Is this CHILD a:
○ Boy ○ Girl

94. What is this CHILD'S age?
Years ① ② ③ ④ Months ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪

By using the example below, please answer the following questions:



95. What is YOUR age?

96. What is YOUR Zip code?

97. What language is spoken MOST OFTEN at home? *(Choose one only)*
○ English ○ Both Spanish and English ○ Spanish ○ Other (Please specify) _____

98. What is YOUR race? *(Choose all that apply - you can choose more than one)*
○ White, non-Hispanic ○ White, Hispanic ○ Black, non-Hispanic ○ Black, Hispanic
○ Native American, non-Hispanic ○ Native American, Hispanic ○ Pacific Islander, non-Hispanic ○ Pacific Islander, Hispanic
○ Asian, non-Hispanic ○ Asian, Hispanic ○ Other (Please specify) _____
○ I DO NOT want to answer

99. What is the highest level of education YOU have completed?
○ 1st - 6th grade ○ 7th - 9th grade ○ 10th - 12th grade
○ High School graduate ○ GED ○ Some College
○ Associate's degree or Technical College degree ○ Bachelor's degree or higher

YOU HAVE FINISHED THIS SURVEY.
PLEASE COMPLETE ANY ADDITIONAL (Women or Infants) SURVEYS AS NEEDED. THANK YOU!

PLEASE DO NOT WRITE IN THIS AREA

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APPENDIX B

WIC Food Packages by State

	Allowed processed forms of F&V			Participants are allowed to ...		
	Canned	Dried	Frozen	Combine tender on F&V purchase	Redeem multiple CVVs in a trx	Redeem CVVs at farmers mkts
Alabama	–	–	–	Yes	–	–
Alaska	√	–	√	Yes	Yes	n.s.
Arizona	√	–	–	Yes	–	Yes
Arkansas	–	–	√	Yes	Yes	–
California	√	–	√	Yes	–	Yes
Colorado	–	–	√	–	–	–
Connecticut	√	–	√	Yes	Yes	n.s.
Delaware	–	–	–	–	Yes	–
District of Columbia	–	–	–	Yes	–	Yes
Florida	√	–	√	Yes	–	–
Georgia	√	–	√	Yes	n.s.	Yes
Hawaii	–	–	√	Yes	–	–
Idaho	–	–	–	Yes	–	–
Illinois	√	–	√	–	–	–
Indiana	–	–	–	Yes	–	–
Iowa	–	–	√	Yes	Yes	Yes
Kansas	√	–	√	Yes	Yes	–
Kentucky	–	–	–	Yes	–	–
Louisiana	–	–	–	Yes	–	–
Maine	√	–	√	–	–	Yes
Maryland	√	–	√	Yes	–	–
Massachusetts	√	–	√	–	–	–
Michigan	–	–	–	Yes	–	–
Minnesota	√	–	√	Yes	–	Yes
Mississippi	√	–	–	n.s.	n.s.	n.s.
Missouri	–	–	√	–	Yes	–
Montana	–	–	√	–	–	–
Nebraska	–	–	–	–	–	–
Nevada	–	–	–	Yes	Yes	–
New Hampshire	√	–	√	–	–	–
New Jersey	√	–	√	Yes	–	Yes
New Mexico	√	–	√	Yes	n.s.	Yes
New York	√	–	√	Yes	–	Yes
North Carolina	√	–	√	Yes	Yes	–
North Dakota	–	–	–	Yes	–	–
Ohio	√	–	√	Yes	Yes	Yes
Oklahoma	–	–	√	Yes	Yes	Yes
Oregon	–	–	√	Yes	Yes	–
Pennsylvania	√	–	√	Yes	Yes	–
Rhode Island	√	–	√	Yes	Yes	Yes
South Carolina	–	–	√	Yes	–	Yes
South Dakota	–	–	√	Yes	–	–
Tennessee	–	–	√	Yes	–	–
Texas	–	–	√	–	Yes	–
Utah	–	–	–	–	–	–
Vermont	√	–	√	Yes	Yes	–
Virginia	√	–	–	Yes	–	–
Washington	–	–	–	Yes	Yes	–
West Virginia	–	–	–	Yes	–	–
Wisconsin	√	–	√	Yes	Yes	–
Wyoming	–	–	–	–	Yes	–

	Milk substitutes (Soy & Tofu)	Alternatives to canned tuna			Substitutes for 100% whole wheat bread					
		Mackerel	Salmon	Sardines	Tortillas		Brown Rice	Bulgur	Oats	Barley
					Corn	Wheat				
Alabama	–	–	√	–	–	–	√	–	–	–
Alaska	Both	–	√	√	√	√	√	–	–	–
Arizona	Both	–	√	–	√	–	√	–	–	–
Arkansas	Soy	–	√	–	√	√	√	√	–	–
California	Both	–	√	–	√	√	√	√	√	√
Colorado	Both	–	√	–	√	–	√	–	–	–
Connecticut	Both	–	√	–	√	√	√	–	–	–
Delaware	–	–	√	–	–	–	–	–	–	–
District of Columbia	Both	–	√	–	√	√	√	√	–	–
Florida	Soy	–	√	√	√	–	√	–	–	–
Georgia	Both	–	√	√	√	√	√	–	–	–
Hawaii	Both	–	√	–	√	–	√	–	–	–
Idaho	Both	–	√	√	√	–	–	–	–	–
Illinois	Soy	–	√	–	√	–	√	√	–	–
Indiana	–	–	√	√	√	√	√	–	–	–
Iowa	–	–	√	–	√	–	√	–	–	–
Kansas	–	–	√	–	√	√	√	√	–	–
Kentucky	Tofu	–	√	√	–	√	√	–	–	–
Louisiana	Soy	–	√	√	–	–	√	–	–	–
Maine	Both	–	√	√	√	√	√	√	–	–
Maryland	–	–	√	–	√	√	√	–	–	–
Massachusetts	Both	–	√	–	√	√	√	–	–	–
Michigan	–	–	√	–	√	√	–	–	–	–
Minnesota	Both	–	√	–	√	√	√	√	–	–
Mississippi	–	√	–	–	√	√	√	–	–	–
Missouri	Both	–	√	√	√	√	√	–	–	–
Montana	Soy	–	√	√	√	√	√	–	–	–
Nebraska	Soy	–	√	√	–	–	√	–	–	–
Nevada	Both	–	√	–	√	√	√	–	–	–
New Hampshire	Both	–	√	–	√	√	√	√	–	–
New Jersey	Both	–	√	√	–	√	√	–	–	–
New Mexico	Both	–	√	–	√	√	√	√	√	–
New York	Tofu	–	√	√	–	–	√	–	–	–
North Carolina	Tofu	–	√	–	√	√	√	–	–	–
North Dakota	Soy	–	√	–	√	√	√	–	–	–
Ohio	–	–	√	–	√	√	√	√	–	–
Oklahoma	Soy	–	√	√	√	√	√	√	–	√
Oregon	Soy	–	√	–	√	–	√	–	–	–
Pennsylvania	Both	–	√	–	√	√	√	√	–	–
Rhode Island	Both	–	√	–	√	√	√	–	–	–
South Carolina	Soy	–	√	√	–	√	√	–	–	–
South Dakota	Soy	–	√	√	√	√	√	√	–	–
Tennessee	Both	–	√	√	√	√	√	√	√	√
Texas	Both	–	√	–	√	√	√	√	–	–
Utah	–	–	√	–	√	√	√	–	–	–
Vermont	Both	–	√	–	–	–	√	–	–	–
Virginia	Soy	–	√	–	√	–	√	–	–	–
Washington	Both	–	√	–	√	–	√	√	–	√
West Virginia	Soy	–	√	–	–	–	–	–	–	–
Wisconsin	–	–	√	√	√	√	√	–	–	–
Wyoming	Soy	–	√	–	–	–	√	√	–	–